URS

September 15, 2004

Dr. Kim Hoang
U.S. Environmental Protection Agency
Region IX
75 Hawthorne Street
San Francisco, CA 94105

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RE: **RAC IX Contract 68-W-98-225**
WA No. 116-RARA-09J5
Final 2003 Pumping Tests Technical Memorandum for Extraction Wells EW-108 and EW-112, Muscoy Operable Unit Remedial Action

Dear Dr. Hoang:

Enclosed for your records are two copies of the Final *2003 Pumping Tests Technical Memorandum for Extraction Wells EW-108 and EW-112, Muscoy Operable Unit Remedial Action*. A copy of the final report has been forwarded to Mr. Tom Perina of CH2M HILL, to Mr. Bill Bryden, and to Mr. Mark Eisen.

Please call me at (916) 679-2345 with any questions.

Sincerely,
URS Group, Inc.

Dennis L. Bane, R.G. # 5064
Vice President

DB:rrd

Enclosure

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NEWMARK GROUNDWATER CONTAMINATION SUPERFUND SITE
MUSCOY OPERABLE UNIT REMEDIAL ACTION

2003 PUMPING TESTS
TECHNICAL MEMORANDUM
FOR
EXTRACTION WELLS EW-108 AND EW-112

Prepared for:

Contract No. 68-W-98-225 / WA No. 116-RARA-09J5
U.S. Environmental Protection Agency
Region IX
75 Hawthorne Street
San Francisco, California 94105

Prepared by:

URS Group, Inc.
2870 Gateway Oaks Drive, Suite 300
Sacramento, California 95833

September 2004

DISCLAIMER

This technical memorandum has been prepared for the United States Environmental Protection Agency by URS Group, Inc. (URS). This document is intended to transmit the information collected by URS during the EW-108 and EW-112 extraction well pumping tests performed in March 2003 at the Newmark Groundwater Contamination Superfund Site, Muscoy and Newmark Operable Units.

The limited objective of this memorandum, the ongoing nature of the project, along with the evolving knowledge of site conditions and chemical effects on the environment and human health, must all be considered when evaluating the memorandum because subsequent facts may become known that may make this document premature or inaccurate.

This memorandum has been prepared by URS under the review of registered professionals. The conclusions and recommendations in this memorandum are based upon URS' data evaluation. The interpretation of the data and the conclusions drawn were governed by URS experience and professional judgment.

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TABLE OF CONTENTS

Section **Page**

LIST OF TABLES

(Provided at the end of this report)

LIST OF FIGURES

(Provided at the end of this report)

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ACRONYMS AND ABBREVIATIONS

EPA	United States Environmental Protection Agency
EW	extraction well
gpm	gallons per minute
I-215	Interstate 215
msl	mean sea level
OU	operable unit
SBMWD	City of San Bernardino Municipal Water Department
SECOR	SECOR International, Inc.
URS	URS Group, Inc.

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1.0 INTRODUCTION

This technical memorandum presents the activities and findings associated with the pumping test of extraction wells (EWs) EW-108 and EW-112 at the Muscoy Operable Unit (OU) of the Newmark Superfund Site (Figure 1-1). The work was conducted by URS Group, Inc. for the U.S. Environmental Protection Agency (EPA). Pumping tests were conducted during March of 2003.

1.1 PURPOSE OF PUMPING TESTS

These two Muscoy OU extraction wells were tested as part of a larger aquifer pumping test effort performed by others. The larger effort entailed individually pumping each of the five Newmark OU extraction wells (EW-1 through EW-5) and the two Muscoy OU extraction wells (EW-108 and EW-112) and performing a combined pumping test of all seven extraction wells (Figure 1-2 shows the well locations). Each test was analyzed. The Newmark OU tests were analyzed by Secor International, Inc. (SECOR) for the City of San Bernardino Municipal Water District (SBMWD), and the Muscoy OU tests were analyzed by URS for the EPA. The aquifer testing was performed in accordance with the *Work Plan for Newmark and Muscoy Plume Front Extraction Well Network Aquifer Testing* (SECOR, 2002).

The purpose of the Muscoy OU extraction well installation and testing was to collect data to further evaluate the capture zones for downgradient hydraulic containment of the Muscoy contaminant plume. In addition, the installation and testing of the groundwater extraction wells will provide a better understanding of the extraction system flow rates, aid in the full-scale Muscoy plume extraction system design, and assist in the selection of the number and location of additional extraction wells. The lithologic data from the extraction boreholes provided further definition of the site stratigraphy. Finally, the water-level response data collected during pumping further defined the hydraulic interconnection between the stratigraphic units and provided a better understanding of the site hydrogeology.

1.2 BACKGROUND INFORMATION

EW-108 was previously tested, along with a brief step test, in 2001. Data collected from the 2001 test was problematic, and a complete analysis was not conducted. EW-112 also was tested previously, in May and June of 2001. The results of this pumping test are presented in the *Extraction Well EW-112 Pumping Test Technical Memorandum Newmark Groundwater Contamination Superfund Site, Muscoy Operable Unit Remedial Action* (URS Group, Inc., 2002). Because very few observation wells were available for the test in 2001, the analysis was limited. Subsequent to the 2001 test, several monitoring wells were installed south of EW-108 and EW-112 that could be used to observe water-level response and, ultimately, to estimate aquifer parameters over the area of the extraction well field.

1.3 DOCUMENT ORGANIZATION

Section 1.0 of this memorandum outlines the scope and purposes of the recent efforts. Section 2.0 documents the procedures and results from the pumping tests of EW-108 and EW-112. Section 3.0 presents conclusions, and Section 4.0 lists references cited in this memorandum. Appendix A of this technical memorandum presents the individual aquifer test hydrographs. Appendix B presents the aquifer test analysis graphs and data.

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2.0 AQUIFER PUMPING TESTS

This section summarizes the methods and results of the aquifer testing. These tests included constant discharge pumping tests on EW-108 and EW-112 followed by recovery tests. The constant discharge pumping tests provided estimates of aquifer hydraulic characteristics that will be useful in evaluating and designing the remedial system. In addition, water-level response data from the observation wells during the pumping tests were used to further evaluate the hydraulic interconnection between the water-bearing zones.

2.1 METHODS AND PROCEDURES

Two separate aquifer testing events were conducted. The first began on March 6, 2003, using EW-108; the second began on March 13, 2003, using EW-112. The tests were conducted following the pumping tests of the five Newmark OU extraction wells and before the simultaneous combined pumping of all seven extraction wells.

For both constant discharge tests, water-level drawdown and recovery were measured in EW-108 and EW-112, EW-1 through EW-5, and all monitor wells and municipal wells within approximately 2 miles of the test well. In addition, water agencies were notified of the testing, and production wells were shut down in the immediate vicinity of the test area to minimize any interference caused by pumping of these wells. The monitoring program for the EW-108 and EW-112 wells is summarized in Tables 2-1 and 2-2, respectively.

During the pumping test, the water levels were measured in observation wells completed in the same aquifer zones as EW-108 and EW-112, as well as those wells above and below the pumped aquifer zone. EW-108 screened elevations are from 609 to 529 and 449 to 119 feet mean sea level (msl). The aquifer thickness in the area of EW-108 is 600 feet, which corresponds to an elevation of 600 to 0 feet msl. EW-112 screened elevations are from 902 to 444 and 382 to 292 feet msl. The aquifer thickness in the area of EW-112 is 620 feet, which corresponds to an elevation of 1,020 to 400 feet msl. The well screen elevations for each monitoring well also are included in the Tables 2-1 and 2-2.

Water levels were monitored on a total of 66 wells for the two tests. The water levels were measured using electronic data logging equipment and manually operated electronic sounders to verify the data logging data results. Water levels were monitored before the constant discharge test and for an extended time after water-level recovery to identify background fluctuations in water levels not related to the aquifer testing. In addition, flow rate measurements were recorded electronically and verified by flow rate and cumulative volume measurements recorded from the flow meters installed on the two wells.

No adjustments of the pumping rate were required during the test. Before the pump was shut off, the electronic data loggers were reprogrammed to begin collecting water-level recovery measurements. Well recovery testing of the constant drawdown pumping test began after pumping ceased. Since the two pumping tests were conducted following the testing of EW-1 through EW-5 and before the combined tests with all wells operating, electronically recorded water-level data are available from all locations from approximately December 2002 through April 2003. These data were used to confirm general background trends in the test area.

The water level in the well during the test was monitored manually using an electronic water-level sounder and automatically monitored using a pressure transducer and data logger throughout the duration of the test. All manual measurements collected during the aquifer tests were recorded manually onto data sheets. The logger was programmed for collection of frequent (1-second up to 10-minute intervals) water-level measurements. Field clocks and the data logger's internal timer were synchronized with the National Bureau of Standards clock.

Water-level drawdown and recovery data from the constant discharge tests were analyzed for estimates of transmissivities and storativity using analytical methods considered appropriate for the site-specific data. These methods included Theis Drawdown and Theis Recovery (Theis, 1935), Cooper and Jacob (1946), and Hantush and Jacob (1955). Per agreement between the EPA and SBMWD, wells that showed less than approximately 2 feet of drawdown were not analyzed as part of this pumping test, with the exception of MW-136B and MW-10A, which were included to expand the area coverage of the test. Water-level data were analyzed using the computer program AquiferTest©, version 3.01. AquiferTest© is a menu-driven program that contains analytical solutions for pumping tests in various aquifer types.

The aquifer testing and analysis were performed using commonly accepted procedures. The constant discharge tests and recovery tests were completed as follows:

- A 95-hour constant discharge test on EW-108. The test was initiated at 15:00 on March 6, 2003, at an average flow rate of 2,292 gallons per minute (gpm).
- A 72-hour recovery test. EW-108 was shut down at 14:00 on March 10, 2003, and water-level recovery data were collected until March 13, 2003.
- A 95-hour constant discharge test on EW-112. The test was initiated at 15:00 on March 13, 2003, at an average flow rate of 2,237 gpm.
- A 48- to 72-hour recovery test. EW-112 was shut down at 14:00 on March 17, 2003, and water-level recovery data were collected on March 19 and 20, 2003, at the various well locations.

2.2 BACKGROUND WATER-LEVEL CONDITIONS

Observed drawdown and water-level recovery data can be influenced by background conditions in the test area/basin and may need to be corrected before analysis for estimates of aquifer parameters. Background or external influences in the basin could be the result of natural recharge or drainage, barometric pressure, or influence from operations of nearby production wells, as discussed in this section.

2.2.1 Barometric Effects

Background water-level conditions were evaluated by reviewing hydrographs of the electronic water-level measurements collected throughout both pumping tests. Barometric pressure also was recorded throughout the tests from a barometer installed at wells MW-137 and MW-15. The hydrographs begin on March 6, 2003, with the start of the EW-108 pumping test, and generally continue through the recovery period for the EW-112 test (March 19 or 20, 2003). Hydrographs of measured water levels from the extraction and observation wells are presented in Appendix A. (As previously noted, the monitoring period for the seven extraction wells was initiated by SECOR on January 6, 2003, and continued through March 23, 2003.) The startup and shutdown of pumping for EW-108 and EW-112 constant discharge and the recovery tests are indicated on the hydrographs. Please note that the vertical scales on the hydrographs differ. The barometric pressure recorded during the test is plotted on the right side of the hydrograph with a different vertical scale. The change in barometric pressure at first appears significant on the plots (when compared to the water-level data). However, as discussed in the following paragraph, this change is minimal when actual magnitudes are evaluated.

As expected, the barometric pressure fluctuates considerably (see hydrographs in Appendix A). However, the magnitude of the fluctuations is approximately 0.2 foot for the EW-108 test and approximately 0.4 foot during the EW-112 test over the duration of the tests. This fluctuation is considered minimal (2% to 6%) when compared to the amount of drawdown (2 to 7 feet) observed in the observation wells used for estimates of aquifer parameters. The barometric effects on the pumping test analysis are further minimized because the Theis analyses were generally performed on the early time data, and the water-level data were not corrected for any barometric effects.

2.2.2 Regional Groundwater Trend Evaluation

Increases and decreases in water levels that are not related to operation of the test wells are observed on the hydrographs. For example, the hydrograph for MW-12B and C (Appendix A) shows an obvious water-level decrease and increase related to the startup and shutdown of test well EW-108. However, a steady decrease in water levels also is observed beginning on about March 12, 2003, followed by a steady increase beginning on about March 16, 2003. These effects do not appear to be related to the startup and shutdown of EW-112. Furthermore, comparing the water level at the startup of pumping EW-108 with the maximum water-level recovery after shutdown, the decreasing trend began prior to the startup of the EW-108 test. This trend is confirmed by the larger water-level data set collected by SECOR. These trends may be attributed to natural drainage/recharge in the test area/basin and possibly responses from the operation of more distant wells outside of the immediate test area but in the same basin. Although there are no obvious effects from the shutdown and startup of nearby production wells during the two pumping tests, the steady increasing and decreasing trends are apparent on the hydrographs. Therefore, interference from these trends was evaluated to determine possible impacts on the test results, as discussed hereafter.

As noted, groundwater elevations recorded before, during, and after each of the pumping tests conducted at EW-108 and EW-112 indicated that another influence(s) or regional trend, besides the pumping at EW-108 or EW-112, was affecting groundwater elevations. The influence(s) appeared to be more significant during the EW-108 test and was represented by groundwater elevations not recovering to pre-pumping elevations followed by groundwater elevations decreasing at a steady rate after the initial recovery period. An example of the “incomplete” recovery and decreasing trend during recovery can be seen in groundwater elevations recorded at MW-12 (see Appendix A, MW-12 hydrograph). Without the benefit of data from a “background” well to quantify the trend, URS attempted to compensate for the trend by “modifying” the data.

The first step was to create a data set that would parallel the observed trend. This data set consisted of two data points, one before pumping began at EW-108 and one later in the test, after pumping had stopped but before the EW-112 test had begun. Next, a line was plotted between the points, and a spreadsheet was used to add a linear trend line to the plotted data and to provide an equation of a line for the trend. An example of the trend line and equation is shown on Figure 2-1.

Next, the equation of the line (where y is the groundwater elevation at anytime of x) was used to create a complete data set of groundwater elevations during the test that would simulate the observed decreasing trend. The groundwater elevations of the trend were then subtracted from the assumed static elevation, thereby estimating the net effect of the groundwater trend at any time "x." This difference was then applied to the observed groundwater elevation at the same time "x," creating a data set of modified groundwater elevations for the entire test, including pumping and recovery stages.

As shown on Figure 2-1, the correction was successful in reducing the effect of the regional trend because the post-pumping groundwater elevations are approximately equal to pre-pumping levels. However, the increase in groundwater elevations during the mid- to late-pumping period indicate the elevations were overcorrected during this period, creating a false recharge.

To compensate for the false recharge, the slope of the regional trend was decreased, and the process of "modifying" the data was repeated. Although the subsequent modified data eliminated the appearance of false recharge, the groundwater elevations following pump shutdown did not return to pre-pumping levels.

Disregarding the shortfalls of each of the correction methods, several sets of original data and corrected data were evaluated with AquiferTest© software. The AquiferTest© software allows for analysis of data using several different aquifer test methods. For the purposes of this evaluation, the Theis drawdown method was used to analyze the data. Analysis of the uncorrected data for the EW-108 test reported a range of transmissivity values between 22,700 and 68,900 square feet per day (ft^2/day). Corrected values of transmissivity ranged between 21,300 and 103,000 ft^2/day. Based on the relative similarity in transmissivity values, it appears that the correction of the data does not significantly affect the transmissivity values.

Consequently, EPA and SBMWD agreed that the analysis of the EW-108 and EW-112 data would proceed using only the uncorrected data. This was determined to be a valid approach when using the Theis method because effects of the regional trends were minimal when compared to the amount of drawdown observed during the early portion (less than 24 hours) of the pumping test drawdown. In addition, as a result of this evaluation, and considering the minimal regional trends observed in the monitoring wells located in the EW-112 test area, the drawdown data were not modified for EW-112 test analysis.

As discussed in the previous paragraph, the monitoring wells located in the EW-112 test area did not show the pronounced regional trends observed in monitoring wells during the EW-108 test. This can be observed in the hydrograph for MW-136. As shown on the hydrograph, the deeper well, MW-136C, showed an obvious response to pumping at EW-108 and also displayed the regional trend during the EW-108 test. Conversely, MW-136A and MW-136B showed minimal change in water levels during the EW-108 test; however, a relatively good response to pumping from EW-112 was observed in these two wells. This indicates the presence of limited hydraulic connection between the two test areas (EW-108 and EW-112). For example, the deeper completion appears to have a good response or hydraulic connection to pumping from the east at EW-108; the mid to shallow portions of the aquifer show a good hydraulic connection to pumping from the west at EW-112. This condition is further discussed hereafter.

2.2.3 Local Groundwater Response to Pumping

General water-level response to pumping for the two aquifer tests is mapped on Figure 2-2. This response is apparent on the hydrographs included in Appendix A. Wells that showed a significant response to the EW-108 and EW-112 pumping tests are color-coded on Figure 2-2. The magnitude of the water-level change/decline is summarized in Table 2-3. Note that the water-level change presented in Table 2-3 includes maximum observed drawdown and a correction for the previously discussed regional trend. This trend is generally greater in wells east of Interstate 215 (I-215).

As shown on Figure 2-2, water-level response from the EW-108 test was observed in most monitoring wells located to the south and east (or east of I-215) of the test well, suggesting all monitored zones are influenced by pumping. An exception would be wells MW135A, MW12A, and MW-14A. These wells are completed in the shallow unconfined aquifer and generally did not respond to pumping from the underlying confined aquifer, as expected. General response to pumping west of EW-108 was limited to wells MW136C, MW-138C, MW-128C, and MW130C, which have the deepest completion at those monitoring well locations. With the exception of these deeper wells, no response to pumping from EW-108 was observed in other shallow and mid-depth wells completed west of I-215. Based on the relative proximity of the MW-136 well cluster to EW-108 (where we could expect to see drawdown in all three wells under uniform radial flow conditions) and the relatively good water-level response observed in wells to the east of EW-108, it appears the hydraulic connection is limited to the west. The transition to a change in hydrogeologic conditions appears to be supported by the EW-112 pumping test, as indicated by the significant response in wells west of I-215, and the previously discussed background trend that is not as pronounced in the EW-112 test area.

The difference in hydrogeologic conditions between the two test areas appears to be consistent with the results of the hydrostratigraphic analysis performed on the aquifer material containing the Muscoy and Newmark Plumes (URS Group, Inc., 2004). These results generally showed that: 1) gravel layers dominate the lower part of the depth intervals penetrated by extraction wells east of I-215 (EW1 through EW-4 and EW-108); and 2) sands with interbedded silt and clays are the more common lithology in wells west of I-215 (MW-136 through MW-139 and EW-112). Therefore, coarse-grained sediments are thicker east of I-215, where the Newmark extraction wells are constructed.

2.3 AQUIFER TEST RESULTS

This section presents the estimated aquifer parameters and summarizes drawdown data from the constant discharge tests. During the constant discharge test, drawdown and recovery data were measured in the observation wells completed in the same aquifer zones as the pumped well, as well as those wells screened above and below the pumped aquifer zone. The hydrographs are provided in Appendix A. Analysis for aquifer parameters was performed using the drawdown and recovery data from wells completed in the pumped aquifer zone. Prior to the analysis, the observation wells were evaluated for partial penetration as discussed hereafter.

2.3.1 Partial Penetration Evaluation

As part of the test analysis, URS initially evaluated the need for correction of partial penetration effects on the water-level data collected from the observation wells. These effects are developed in the aquifer when the test well screen is not constructed across the entire saturated thickness of the aquifer. Under these conditions vertical groundwater flow can be induced around the pumping well. These effects can cause localized drawdown anomalies and bias aquifer parameter calculations.

Partial penetration effects were, however, not applicable to the pumping test analysis because of the relatively large distances between the pumping wells and observation wells. All but two of the observation wells (MW-135B and MW-135C at 1,398 feet) were approximately 1,500 feet from the pumping well for both the EW-108 and EW-112 tests. URS examined the distance criteria for assessing partial penetration effects as discussed in *Analysis and Evaluation of Pumping Test Data* (Kruseman and de Ridder, 1983). Section 4.6, Partially Penetrated Aquifers, indicates observation wells at distances greater than r = 2D incur essentially no partial penetration effects; where, r is the radial distance between the pumping and observation well and D is the aquifer saturated thickness. Based on URS' geospatial lithologic model, saturated thicknesses for the EW-108 and EW-112 pumping tests were determined to be 600 and 620 feet, respectively. These saturated thicknesses correspond to a radial distance, r, of 1,200 feet and 1,240 feet. As indicated, all of the observations analyzed for the EW-108 and EW-112 tests were greater than these distances from the applicable pumping wells. Consequently, correction for partial penetration effects on the data from the observation wells was not necessary.

2.3.2 Aquifer Parameters

Data collected during groundwater extraction and after extraction had ceased were used to estimate aquifer parameters. Water-level drawdown and recovery data were analyzed for estimates of transmissivities and storativity using analytical methods considered appropriate for the site-specific data. These methods included Theis Drawdown, Theis Recovery (Theis, 1935), Cooper and Jacob (1946), and Hantush and Jacob (1955). The Theis Drawdown, Theis Recovery, and Cooper and Jacob methods are applicable to confined aquifer conditions, and the Hantush and Jacob method is applicable for semi-confined aquifer conditions. Table 2-3 summarizes the results from the constant rate tests on wells for the EW-108 and EW-112 pumping test. This table includes maximum drawdown, regional water-level trend (if applicable), adjusted drawdown, and estimates of transmissivities, hydraulic conductivity, and storage coefficient using the Theis Drawdown method.

The Theis method is considered most applicable to the site based on the confined aquifer conditions. The results from the Theis analysis are presented in Table 2-3. Results of the other methods used for analysis, Theis Recovery, the Cooper and Jacob method (confined aquifer), and Hantush and Jacob (semi-confined aquifer), are included in Appendix B for comparison purposes (see Table B-1, Appendix B). Cooper and Jacob (1946) showed that under most conditions ($u = [r^2S/(4Tt)] \leq 0.01$) the Theis equation can be approximated by what is commonly referred to as the Cooper and Jacob method. This approximation also applies to the Theis Recovery method. Logarithmic plots of drawdown and recovery for all analyses from the pumping tests are presented in Appendix B. Plots include the estimated aquifer parameters for each respective analysis.

The results from these other methods are included in Appendix B to show that the early-time data indicate a confined aquifer response. The results are essentially the same for the Theis and Hantush leaky aquifer methods; therefore, only the Theis method results were included in the body of the report. The late-time pumping data (which could show a leaky type response) and recovery data were obscured by interfering background water-level trends and precluded reliable analysis.

As indicated in Table 2-3, the transmissivity from the EW-108 test ranged from 2.29×10^4 ft^2/day to 6.89×10^4 ft^2/day. The arithmetic and geometric mean, along with the median and standard deviation, for all parameters also are provided in the table. The storage coefficient ranged from 1.08×10^{-3} to 8.50×10^{-4} for the EW-108 test. The transmissivity from the EW-112 test ranged from 1.71×10^4 ft^2/day to 3.90×10^4 ft^2/day. The storage coefficient ranged from 1.16×10^{-3} to 9.50×10^{-4} for the EW-112 test. Per the agreement between EPA and SBMWD, the results from the EW-112 pumping test for monitoring well MW-130B were not used. The results for all analysis methods with well MW-130B were consistently anomalously high (7.30×10^4) compared to the other well results (often by almost 10 times). The cause of the anomalously high results is unknown. The EW-112 pumping test conducted in 2001 arrived at transmissivity values, using the Theis method, that ranged from 2.55×10^4 ft^2/day to 6.25×10^4 ft^2/day (URS Group, Inc., 2002).

Table 2-3 summarizes the estimated hydraulic conductivity for each test. Using the previously mentioned aquifer thicknesses of 600 feet for the EW-108 test and 620 feet for the EW-112, hydraulic conductivities ranged from 38 to 115 ft/day and 28 to 63 ft/day, respectively.

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3.0 CONCLUSIONS

Based on the results of the aquifer tests using EW-108 and EW-112, the following general conclusions are made.

- There appears to be a difference in hydrogeologic conditions between the two test areas. Although similar pumping rates and aquifer parameters are observed in both areas, the hydraulic connection between the two areas appears to be limited in the general area of the I-215 freeway. This appears consistent with the difference in aquifer material noted in the geospatial lithologic model. These conditions should be further evaluated and or considered during extraction system design.
- The hydraulic conductivity of the aquifer material for the EW-108 test and the area east of I-215 is generally greater than that for the EW-112 test and the area west of I-215.
- For the EW-108 test area and the area east of I-215, transmissivity ranged from 2.29×10^4 ft^2/day to 6.89×10^4 ft^2/day. The EPA and SBMWD agreed that evaluation of analytical capture zone calculations should be based on the arithmetic mean transmissivity ± two standard deviations. Arithmetic mean transmissivity was 4.32×10^4 ft^2/day ± 1.56×10^4 ft^2/day. Arithmetic mean hydraulic conductivity was 72 ft/day ± 26 ft/day. Arithmetic mean storage coefficient was $9.08 \times 10^{-4} \pm 1.31 \times 10^{-3}$.
- For the EW-112 test area and the area west of I-215, transmissivity ranged from 1.71×10^4 ft^2/day to 3.90×10^4 ft^2/day. Arithmetic mean transmissivity was 2.81×10^4 ft^2/day ± 6.72×10^3 ft^2/day. Arithmetic mean hydraulic conductivity was 45 ft/day ± 10 ft/day. Arithmetic mean storage coefficient was $1.22 \times 10^{-3} \pm 9.79 \times 10^{-4}$.

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